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(19)

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(54) IMPROVEMENTS IN OR RELATING TO BLOW MOULDING APPARATUS

(71) We, FARRELL PLASTIC MACHINERY CORPORATION, a corporation of the State of New Jersey, United States of America of 1 Cory Road, Morristown, New Jersey 07960, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to blow moulding apparatus.

Conventional injection blow moulding apparatus operates through a cycle beginning with the injection of a plastics material into an injection mould containing a core rod. A parison is formed around the core rod, and the injection mould then opens and permits the core rod to move to the next station of the blow moulding machine at which the next step of the moulding process is performed.

The second station is usually a blowing mould in which the parison is blown to the desired shape of a finished article; and when the blown article cools sufficiently, it is removed from the blowing mould and transferred to a stripper station. At the stripper station the blown article is removed from the core rod.

One of the limitations on the speed of a conventional cycle of such an injection blow moulding apparatus is the time required to cool the blown article sufficiently to remove it from the blowing mould prior to introduction to the stripper station. The present invention seeks to provide blow moulding apparatus, in the operation of which it is possible to cool the blown article more quickly than has previously been possible and thereby reduce time cycle of the apparatus and correspondingly increase the production of the blow moulding apparatus.

According to one aspect of this invention there is provided a blow moulding apparatus including a core rod support, a core rod assembly comprising a core rod for supporting a parison to be blow moulded, means near one end of the core rod for connecting it with the core rod support, an elastic balloon that fits closely over the core rod when said balloon is deflated, and means for supplying fluid under pressure from the core rod to inflate the balloon and the parison thereof and including a shroud having a shape similar to the shape of the article to be blown from the parison but somewhat larger, and means to supply a flow of cushioning fluid through the shroud and into contact with the outside of the blown parison within the shroud, the shroud having a multitude of perforations opening through the surface thereof that confronts the blown parison inside the shroud and through which, in operation of the apparatus streams of the cushioning fluid flow into contact with the outside surface of the blown parison.

In a preferred embodiment of the invention, an elastic balloon is attached to a core rod assembly in position to hug the core rod when the balloon is deflated. When a parison is formed over the core rod, it is applied over the outside of the collapsed balloon and over a short length of the core rod assembly beyond the end of the balloon. This short length of the parison is the portion which forms the mouth or neck of the article to be blown and it is a portion of the parison which is not expanded in the blow mould.

The balloon has important advantages. One is that it permits the blown article to be cooled from the inside. Cooling fluid can be circulated through the inside of the balloon during a blowing operation and immediately after the completion of the blowing operation.

The core rod of a preferred embodiment of this invention is constructed so that

cooling fluid flows from inside the core rod into the space between the core rod and the expanding balloon and parison; and this cooling fluid exhausts through other passages communicating with exhaust openings in the side of the core rod. If desired, fluid of any temperature can be circulated for the purpose of obtaining an orientation temperature of the parison before its final expansion to the shape of the desired article.

Preferably the balloon is attached to the core rod assembly in such a way that the balloon connection to the core rod assembly is not subjected to any axial pull when the blown article is being stripped from the core rod. In the preferred construction, a sleeve which has a shoulder on one end, serves as part of the parison supporting surface of the core rod assembly. The balloon is attached to the core rod assembly in an undercut cavity at the shoulder of the sleeve and the diameter of the collapsed balloon is less than that of the sleeve so that the balloon is protected from axial pull when an article blown on the core rod assembly is stripped from the core rod assembly by a stripper plate bearing against the part of the blown article that is formed on the surface of the sleeve.

In utilising an apparatus in accordance with the invention the parison may be cooled from the outside additionally by circulating cooling fluid into contact with the outside of the parison in the blowing mould. A special type of blowing mould is used in which the article is blown within a shroud having a multitude of openings into which fluid enters to form a fluid cushion, preferably an air cushion, inside the shroud. The article is blown into contact with this cushion which increases in pressure as the parison expands towards the inside surface of the shroud. This blowing of the parison against an air cushion instead of into contact with a solid surface is intended especially for use with containers having rigid mouth or neck portions and flexible and pliant body portions.

In order that the invention may be more readily understood, the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic, sectional view, partly broken away, of part of a blow moulding apparatus showing a core rod assembly, placed in a blowing mould in which the parison is expanded against a fluid cushion; and

Figure 2 is an enlarged detail view of a portion of the structure shown in Figure 1.

Figure 1 shows a core rod assembly 14 connected to a core rod support by fastening means such as screws 16.

The core rod assembly 14 includes a base flange or spacer block, and a sleeve has a flange 22 which is attached to the spacer block by the screws 16.

Within the sleeve there is a core rod 26. In the illustrated construction, the base flange or spacer block is an integral part of the core rod 26.

In the portion of the core rod nearest to the support 16 there is a pipe or tube 32 extending coaxially along the length of the core rod, and with the outside diameter of the tube 32 being somewhat less in diameter than the diameter of the hollow interior of the core rod. Near the outer end (right hand in Figure 1) of the tube 32 the interior diameter of the core rod is reduced. The tube 32 fits tightly into the core rod at this portion of reduced diameter; and beyond the end of the tube 32 there is a chamber enclosed by the core rod much of this chamber being broken away in Figure 1.

There are a multitude of openings 40*a* and 40*b* in the exterior surface of the core rod 26. The openings 40*a* communicate with a chamber within the core rod. The openings 40*b* communicate with an annular chamber which comprises the space between the tube 32 and the larger interior diameter portion of the core rod.

In use of the apparatus fluid, either liquid or gas, flows through the tube 32 in the direction indicated by the arrows and this fluid flows out through the openings 40*a* in directions indicated by the arrows near the end of the core rod 26. This circulating fluid which flows out of the core rod 26 through the openings 40*a* flows back through the openings 40*b* back into the annular chamber between the tube 32 and the interior larger diameter portion of the core rod as indicated by the arrows. This exhaust flow is indicated by the arrows along the outside of the tube 32 in Figure 1.

As long as the pressure of the fluid supply to the core rod is adjusted with respect to the back pressure of the fluid exhaust so that pressure builds up within the space surrounding the core rod, a parison 48*a* initially provided on the outside of the core rod will be blown and expanded. The core rod structure shown in Figure 1 can be used in several ways. Fluid can be circulated continuously through the openings 40*a* and 40*b* so as to cool the parison 48*a* from the inside, or to bring it to a particular temperature desired for orientation of the parison, or a given quantity of liquid can be injected into the parison from the openings 40*a* while liquid in the exhaust passage of the core rod is blocked.

When a given volume of liquid is thus introduced into the parison from the core rod, while exhaust of liquid from the pas-

sages 40*b* is blocked, then the parison will be blown to a predetermined volume depending upon the volume of the liquid. The shape of the blown article, under such circumstances, can be determined at least partially by the balloon 50 attached to the core rod assembly in a manner which will be explained. The thickness and elasticity of the walls of the balloon 50, which can be different at different locations if desired, determines the shape to which the balloon expands and thereby at least partially determines the shape of the article blown from the parison 48*a*, even though the blowing is not performed in a blowing mould.

The balloon 50 is an elastic balloon which is permanently connected to the core rod assembly and this balloon hugs the outside surface of the core rod 26 when the balloon is collapsed.

The use of such a balloon is advantageous because it permits the circulation of cooling fluid inside the balloon and parison at substantial velocities for rapid cooling and such circulation of cooling fluid could not be used if in direct contact with the molten parison 48*a*. Another advantage of the balloon 50 is that it permits the parison to be expanded by the use of much higher pressures than are conventional and the use of such higher pressures makes possible the blowing of the parison at orientation temperatures where the plastics material of the parison is beginning to solidify and the parison cannot be expanded except by the use of much higher pressures than are used for conventional blow moulding. Such pressures could not be used without the balloon because of the risk of bursting the wall of the parison at points which were somewhat weaker than other points.

The end of the mouth portion of the balloon extends into an undercut recess of the sleeve which surrounds tube 26 and as an additional feature for increasing the strength of this connection there may be screw threads as part of the wall of the undercut recess 54. The portion of the balloon bulges into the undercut recess is jammed between the sleeve and the core rod that the sleeve surrounds, as shown in Figure 1, adhesive may be used to obtain a tight connection between the balloon 50 and the sleeve.

Figure 1 also shows a blowing mould indicated generally by the reference character 106. An upper mould part 108 separates from a lower mould part 110 along a plane 112 in order to open the mould.

The mould 106 encloses a cavity 113 which contains a shroud 114 of circular cross section at right angles to the longitudinal axis of the core rod 26. The shroud 114 is made in two parts, one of which is attached to the upper mould section 108 and the other to the lower mould section 110. The parts of the shroud 114 separate along the plane 112 in the same manner as the upper and lower sections of the mould 106.

Air or other gas is introduced into the cavity 113 through a supply pipe 118 in the direction indicated by the arrow 120. This air enters the cavity 113 around the outside of the shroud 114 which is smaller than the cavity 113 in both its vertical and horizontal extent. There is clearance around the shroud 114 so that the air circulates freely and the pressure is substantially the same in both the upper and lower parts of the cavity 113.

Figure 2 shows a portion of the shroud 114 on a larger scale. There are a multitude of small openings 124 through the shroud 114 over substantially the entire area of the shroud. These openings 124 are not shown in Figure 10 because the scale of Figure 1 is too small.

Figure 2 shows the way in which air entering the inside of the shroud 114 impinges on the surface of the parison 48*a*. The air flow is indicated by arrows 126; and the jets of air flowing into the inside of the shroud 114 through the openings 124 are strong enough to build up an air cushion in the shroud 114. The parison 48*a* is expanded by the balloon 50 against this cushion of air.

The pressure of the cushion of air within the shroud 114 increases as the parison 48*a* is expanded until the pressure approaches the upstream pressure of the air at the upstream sides of the openings 124.

The temperature of the air introduced into the chamber 113 can be at the orientation temperature of the material of the parison 48*a* so that the parison is blown at its orientation temperature to produce a stronger container wall. Cold air can be introduced into the chamber 113 toward the end of the blowing period to cool the parison 48*a* quickly to a temperature below its melting point so as to facilitate collapse of the balloon 50 and removal of the core rod assembly, balloon and parison from the blowing mould.

Air is withdrawn from the inside of the shroud 114 through an exhaust pipe 130 at a controlled rate which depends upon the pressure buildup desired within the shroud 114.

The operation illustrated in Figures 1 and 2, in which the parison is blown against an air cushion instead of being blown into contact with a solid wall of a blow mould cavity is intended primarily for making containers which have thin walls that are pliant and flexible in the

finished container. Such containers are made with a thick and rigid neck or mouth portion 134 as illustrated in Figure 1. This mouth portion 134 is, however, made of the same material as the rest of the parison and is therefore of one-piece construction with the flexible walls of the container. Such a construction is obtained by having an injection mould with more space for parison material in the region of the neck than in the portion that will form the side wall of the container, or by designing the apparatus so as to expand the wall portion substantially more than with the usual blown plastics container.

WHAT WE CLAIM IS:

1. A blow moulding apparatus including a core rod support, a core rod assembly comprising a core rod for supporting a parison to be blow moulded, means near one end of the core rod for connecting it with the core rod support, an elastic balloon that fits closely over the core rod when said balloon is deflated, and means for supplying fluid under pressure from the core rod to inflate the balloon and the parison thereof and including a shroud having a shape similar to the shape of the article to be blown from the parison but somewhat larger, and means to supply a flow of cushioning fluid through the shroud and into contact with the outside of the blown parison within the shroud, the shroud having a multitude of perforations opening through the surface thereof that confronts the blown parison inside the shroud and through which, in operation of the apparatus streams of the cushioning fluid flow into contact with the outside surface of the blown parison.

2. A blow moulding apparatus according to claim 1 wherein the multitude of perforations through the shroud are small openings distributed over most of the surface of the shroud that confronts the blown parison, and a larger opening is provided in the shroud through which, in operation of the apparatus fluid exhausts from the space enclosed by the shroud so that the fluid flow through the small openings is in a direction toward the blown parison to form a cushion of fluid around the blown parison in the shroud.

3. A blow moulding apparatus according to claim 2 and including means for circulating a temperature controlling fluid through the balloon to control the temperature of the parison from inside the parison, and means for circulating a temperature controlling fluid through the openings in the shroud to control the temperature of the parison from outside the parison.

4. A blow moulding apparatus according to claim 3 wherein the means for circulating fluid inside the shroud but outside of the parison include sources of cooling fluid for cooling the blown parison quickly prior to stripping the article blown from the parison from the core rod.

5. A blow moulding apparatus according to any one of claims 1 to 4 wherein the shroud is made with two parts which move toward and from one another to open and close the said shroud.

6. A blow moulding apparatus substantially as herein described with reference to and as illustrated in Figures 1 and 2 of the accompanying drawings.

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1546234 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale

FIG.1

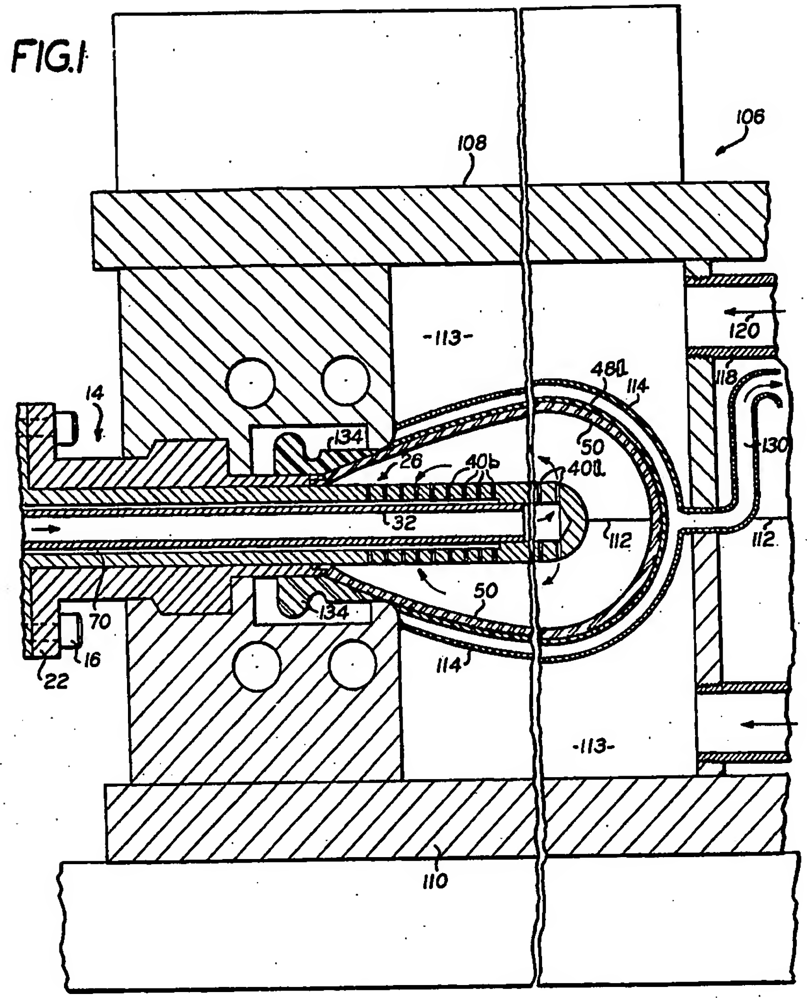

FIG. 2